# SC4: ADVANCED MEMBRANES FOR PURE HYDROGEN PRODUCTION/PURIFICATION

PILOT LINE

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Ultrathin Pd-based membranes produced by electroless to obtain pure hydrogen.

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| tecnalia | PILOT LINE OWNER<br>responsible for the supported membrane fabrication |
| H2SITE Membrane reactors for $H_2$ generation | responsible for the construction and assembly of the membrane reactor technology and setup |
| ENGIE | responsible for testing the set-up and developing the plant |
| Rauschert | responsible for the membrane support manufacturing |
| TU/e | responsible for modelling the hydrogen process |

## THE CONTEXT

About 48% of the global production for H2 is currently generated via steam methane reforming, therefore coming from natural gas with a 70-80% efficiency. About 30% of the hydrogen produced comes from oil/naphtha reforming fromrefinery/chemical industrial off-gases, 18% from coal gasification, 4% from water electrolysis and only a 0.1% from other sources. The PSA technology is practically unbeaten in costs in systems where the hydrogen production method makes use of the fuel coming out with the offgas of the PSA. At large scale applications, PSA yields in the range of 70-85 % while in applications where the hydrogen source does not make use of an available heat source, like the ones at smaller scale, the conventional PSA needs higher pressures to achieve high yields (e.g. about 24 bara for 90 % yield). In the case of on-site H2 recovery, the system needs to be compact and capable of handling different H2 concentration. For this reason, novel membranes that can provide high purity at low costs are required. In fact, preliminary analysis has shown that novel membrane configurations are needed to obtain H2 with high purity (≥5N) at high recoveries.

## THE CHALLENGE

Palladium-based membranes have received a growing interest for the production and purification of H2 since they can be used as an integrated membrane reactor where reaction and separation are coupled. Pd membranes have advantages of high hydrogen flux and exclusive perm-selectivity for H2 due to the unique permeation mechanism18. Since the permeation flux is inversely proportional to the membrane thickness, the development of defect free membranes with a thickness of less than 5 µm with good adherence to the support is the key challenge in order to attain high H2 flux and to minimize the material cost.

## KEY DRIVERS OF THE SERVICE: THE VALUE PROPOSITION

The showcase has shown that the new system achieves a high level of purity in methane reforming, ammonia cracking and biogas reforming. The advantages of using the system are that it lowers the cost of hydrogen and lowers the CO2 footprint of the methane reforming process. In one-step it can Produce H2 from bioethanol, CH4, biogas, green ammonia.

### One-step Process

- In one step, H2 can be produced and separated from bioethanol, CH4, biogas, green ammonia.

### Plug-and-play System

- no need to build added infrastructure
- it can be integrated on-site
- simpler logistics as there is no need for transportation